

## Stunts with Short Pulses

In the mid-1960s, scientists realized that intense laser light could compress and heat matter enough to produce significant amounts of fusion energy, which powers the sun and other stars and could one day provide an inexhaustible source of terrestrial energy. The nuclei in a plasma are all positively charged, so they strongly repel each other when they're close together. But in a hot, dense plasma, they approach each other at such high speeds and so often that many pairs of them can overcome their repulsion and fuse—releasing enormous amounts of nuclear energy.

In the last decade or so, the pursuit of laser-induced fusion has spurred the development of several swimming-pool-size laser systems that produce short pulses with powers well over a trillion watts. In 1996, one beam line of the Nova laser—which was built for fusion research at Lawrence Livermore National Laboratory (LLNL) in 1984—was converted to short-pulse operation. The result was the first petawatt (1,000 trillion watts) laser. The appropriately named "Petawatt" was used to study laser-induced fusion, among other things, before being dismantled in 1999 to make way for LLNL's National Ignition Facility (NIF). The size of three football fields, NIF will house the world's largest laser, which many hope will sustain fusion reactions for a few billionths of a second—an event that could occur as soon as 2010.

With NIF fusion on the horizon, scientists at Trident and other high-power-laser facilities are gearing up to support NIF efforts by exploiting a key discovery made with the Petawatt—that ultraintense short pulses can produce intense beams of electrons, protons, and other ions, as well as intense bursts of high-energy x-rays. The proton beams could be used to ignite fusion plasmas, while the x-rays will be used to take pictures of them.